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Business Cycle Accounting in Japan

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1.Introduction

> The performance of the Japanese economy in the 1990s was less than stellar. The average annual growth rate of per capita GDP was 0.5 percent in the 1991-2000 period. The comparable figure for the United States was 2.6 percent. Japan in the last decade, after steady catch-up for 35 years, not only stopped catching up but lost ground relative to the industrial leader. The question is why.
>
> In Hayashi and Prescott (2002)

In the aftermaths of World War II Japan was a country in tatters with an economic system completely destroyed. They, then, engaged in a tremendous process of economic development that made them, in the beginning of the 1990's, the second largest economy in the world, behind the United States of America, and ahead of the European Union. Japan based its growth on a state oriented market system, where *Keiretsu* were the main star of their industrial organization. This growth process was made with high technology export oriented firms, and with a strong bank based financial system.

However, at the end of 1980's, with the burst of the twin speculative bubble in the real-estate and stock markets, everything changed. This asian country entered in a prolonged period of economic depression, with a very low GDP growth, a very strong deflationary spiral, and a financial system in complete failure. What happened to Japan? What were the economic distortions that made this once economically brilliant country suffer such a deep economic crisis?

In this dissertation I apply the Business Cycle Accounting technology developed by Chari et al. (2004), where a prototype growth model with time varying productivity, labor market frictions and investment frictions is used to replicate the Japanese economic fluctuations. The final aim is to see what kind of economic distortions are

able to explain better the Japanese "lost decade", and to compare the results obtained with the existing literature about Japan's crisis.

The strongest conclusions reached in this dissertation are that: (i) investment market frictions and total factor productivity fluctuations play a very important role in replicating the Japanese economy in the crisis period; (ii) the labor wedge does not play any significant role; and, (iii) the results are very consistent with the literature that explains the Japanese crisis. Consequently, any hypothesis or model that tries to explain what went wrong in Japan should always focus on efficiency and investment frictions.

This dissertation is organized as follows. Section 2 provides a brief explanation of business cycle accounting, as in Chari et al. (2004). Section 3 describes Japan's growth process. The Japanese economic crisis, its causes and its possible wedges are presented in section 4. Section 5 explains the business cycle technology extensively, and provides us with the model's results. Section 6 compares the model's outcomes with the broad literature about the crisis in Japan. Finally, the section 7 presents us the conclusions.

2. A Brief View of the Business Cycle Accounting Technology

The business cycle accounting technology developed in Chari et al. (2004) is used in this dissertation to replicate the Japanese economic fluctuations in the "lost decade". This methodology is briefly presented here, as it is important for a better understanding of what is done in section 3. Later, in section 6, a more extensive explanation of this technology will be presented.

This method has two components, namely, an equivalence result and an accounting procedure. The first one states that a large class of models with various frictions is equivalent to a prototype growth model with time-varying wedges. There are, mainly, four wedges, which are: (i) the efficiency wedge; (ii) the labor wedge; (iii) the investment wedge; and, (iv) the government consumption wedge. These wedges resemble, respectively, time varying productivity, labor taxes, investment taxes, and government consumption. Therefore, any economic distortion that generates an efficiency fluctuation will produce an efficiency wedge. In the same way any economic friction that creates a labor tax, or an investment tax will create a labor wedge, or an investment wedge, respectively. The government consumption wedge is generated by government expenditures. The accounting procedure will assess which wedge is able to better explain the Japanese fluctuations.

In section 4 below, it is presented the main causes and characteristics of Japan's economic crisis, and all the possible wedges found in it.

3. Japan: from the miracle economy to the depression of the nineties

3.1. The Japanese outstanding growth

The Japanese economy was in tatters at the end of World War II. It was a typical war economy where all industries were state-guided to produce the necessary to face the war efforts. With the end of the war the process of reconstructing the nation's economy began. This was done through a program of import substitution and export promotion

focused on home investment intended to create domestic-based firms, specifically hierarchical vertical *Keiretsu* conglomerates (which substituted the *Zaibatsu* dismantled by the Americans). In doing so, Japan entailed an industrial technological upgrade, emulating more developed nations, such as the U.S.

All this process was completely driven by the government in the form of protectionist regulations and through investment guidance using a state-augmented bank-based financial system to channel the capital stock to policy-targeted sectors and projects. Therefore each bank in the "Main Bank System" would finance their own *Keiretsu* group, under the close supervision and control of the government. In this development process stock and bond markets were completely repressed by state authorities.

The result of this strategy was an outstanding period of economic growth between the 1950's and the first oil shock in 1973, where Japan produced an average growth rate of 8.8% per year, well above all the other OECD countries (see table I). Between 1973 and 1990 this Asian country experienced also a strong annual growth of 3.8% (still higher than USA and Western Europe). Since then, Japan experienced a complex economic stagnation, with an average annual growth rate of 1.3% between 1990 and 2000. To confirm this crises scenario, Patrick (2002) estimated that if the average growth rate for 1992-2002 in Japan was 2.5%, its GDP would have been 24% higher at 2002.

Table I:
AVERAGE GROWTH OF GDP 1950-2000 (% PER YEAR)

	1950-73	1973-90	1990-2000
Japan	8,8	3.8	1.3
USA	3.6	2.9	3.4
Western Europe	4.9	2.2	2.0

Source: Bigsten (2004)

The event that triggered all of this was the burst, in 1990, of the real-estate and stock speculative bubbles that grew in the 1980's. In that decade, the Japanese Yen suffered a strong appreciation that harmed the economy. In consequence, a very loose and an expansive monetary policy was followed, allowing the interest rates to achieve a post-war low. This policy overheated the economy permitting the creation of stock and real-estate inflation, that peaked in 1989. Japan's Nikkei 225 Stock Average rose from 6000 yen in 1980 to 40000 yen in 1989, while in the same period real-estate prices almost doubled (see Hoshi and Kashyap, 2003).

However, by 1989 those bubbles were considered unsustainable by the Ministry of Finance (MoF) and monetary policy was tightened. The outcome was the end of both speculative bubbles (the Nikkei 225 Stock fell 50% in the first nine months after the burst) and consequently an outburst of deep financial distress with a huge non-performing loan problem and an economic deflationary stagnation.

Notwithstanding the 1990's depression, in the post-war years Japan was able to build the second-largest economy in the world. It is a high-saving, high-investment, low-consumption economy with a very developed industry based mainly on high-tech products such as electric/electronic goods or automobiles, and a stock of quality human.

4. The Japanese "Lost Decade": the crisis and causes

4.1. Financial System Distress

One of the most decisive characteristics of the Japanese lost decade is its financial system meltdown with a huge non-performing loan problem and widespread bankruptcies. All this financial disruption started with the well-known burst of the twin asset and real-estate bubble in the late 1980s, but it seems that this event on its own cannot explain all the deepness of Japan's financial distress. Some more profound and structural features may help to illuminate all this financial mess. Therefore, in the next section it will be made a concise discretion of the Japanese post-war financial system and then the possible causes and character of this crisis will be exposed. In the last part of this section the possible wedges related with this feature will be stated.

4.1.1. Post-War Financial System

Following World War II and in the beginning of an industrial and economic development process, the main objective of the Japanese government, regarding the financial system, was to create a extremely safe and low-cost investment channel that would transfer funds from savers to government-designated" industries which were considered essential for the country growth. So, it was built a bank-based state-regulated financial system where the stock and bond markets were completely repressed. Estimates made by Suzuki (1980) show that, in 1974, 74.1% of all external financial sources were provided through banks. Banks, life insurance-companies and government financial institutions were the most important institutions of the Japanese financial system (Hoshi and Kashyap, 2004).

4.1.2 The Main Bank System

In the Main Bank System (for more details see Patrick, 1998) a main bank has strong business relationships – usually including cross-shareholding - with its industrial customers, lending funds to finance their investments. It involves close monitoring by the bank of the company, gathering exhaustive information on the company's strategy and performances, that otherwise would not be available. In return the bank is obliged to rescue its client when this falls in financial difficulties.

It is an extremely segmented system designed to specialize by size of customer and by term and type of loan. The Big Banks were the core of the banking system. These were divided in city banks (which operate all over the country), trust banks (that accept longer term deposits), and the long-term credit banks (that finance the building and functioning of factories). These were the banks that had the function of financing the large industries. Below them came the regional banks which provided funds to medium and small local firms. To complete this entire *repertoire* there was a whole panoply of deposit-taking institutions – like mutual savings, credit associations or credit co-operatives.

Safety of the system was achieved through a regulatory regime that would not allow new entries and would guarantee that banks would not fail, so that their management, stockholders and depositors were protected. No real competition was authorized hence interest rates were administratively set in a way that financial institutions would have big profits, and new products were not allowed. These regulations gave banks an incentive not to worry with their efficiency and cost structure since large profits were secure.

Moreover, a "convoy" system was built where all banks would grow at the same speed, in a way similar to ships in a convoy, navigating at the pace of the slowest one (Spiegel, 1999). Whenever a financial institution was in trouble, it would be merged with a larger and stronger one. Any losses would be more than offset by the franchise value of the branches and by future favours given by the Ministry of Finance (MoF). Therefore, the system's safety would be provided by the system itself.

One of the main features of this financial system was the close, symbiotic relationship between state authorities, namely the MoF, and the Big Banks, securities companies and insurance companies. A collusive behaviour with the leadership of the MoF existed through severe "(…) administrative guidance, price setting, protection and restriction of competitive impulses" (Patrick, 1998). Due to this promiscuous relations between banks and state, the system was allowed to be extremely opaque with little disclosure and non transparency. This was needed because banks made many loans based on criteria other than creditworthiness.

The Japanese financial system worked well in the post-war fast growth-period, hence it was very safe and it carried out its financial intermediation role. On the other hand it was not a very efficient system since, for the various reasons and practices explain in the previous paragraphs, it produced inefficiency in the allocation of resources. However, the balance was clearly positive until the burst of the crisis.

4.1.3 The Causes and the Character of the Crisis

In this section some of the main causes which contributed for the current situation of financial distress in Japan will be exposed. Later, the major features of this financial mess will be analysed.

4.1.3.1. The Causes

Here, the phenomena that are thought to be the most important origins of the reported crisis will be described. The causes analyzed are: (i) the process of financial deregulation that began in the 1980s in Japan and its consequences; (ii) the ever-greening problem; (iii) the adverse selection and moral hazard problems; (iv) the rise and burst of the twin bubble; (v) the effects of globalization; and (vi) the financial technological innovation.

4.1.3.2. The Process of Financial Deregulation

As described in sub-section Post War Financial System, the Japanese post war system was completely bank-based, i.e. almost all the external funds came from bank loans. Capital markets funding (domestic and international) were non-existent and financial instruments were extremely scarce. However, by the mid 1970's a large process of financial deregulation began. Patrick (1999) argues that one of the main reasons for starting the above mentioned process was the slowdown of the Japanese economic growth, which led to an excess of funds in the lending market. Consequently, interest

rates came down pressuring for a system of market based interest rates where banks could enhance their competitiveness.

Another important reason for this deregulation was the expansionist fiscal policy of the mid 1970's that was intended to fight the recession, implemented with a record issuing of government bonds. Then, for these bonds to be placed, the public authorities had to liberalise the bonds market in some way. This liberalisation proved contagious forcing eventually a progressive deregulation in various important markets such as the money market, the domestic securities market, or the wholesale funds market. With the foreign trade law in 1980, and some relaxation in the restrictions on international financing, this kind of funding has also become a good borrowing font for Japanese companies. Thus, by the end of the 1970's the autarkic and regulated corporate financial system had started a one-way trip to deregulation. This process of deregulation had some negative effects on the Japanese financial system helping to its weakness and later collapse.

The first negative outcome of this process was the fact that it was constructed without the creation of an effective prudential regulation and supervision system adapted to this new environment of free competition. On the opposite the old collusive and "Wait-and-See" regulation of the convoy system was kept (Schaede, 1996). The obvious outcome was still an opaque system with a huge lack of disclosure, full of potential dangerous moral hazards situations.

One second massive consequence was the emergence of a profitability problem: the falling interest rates and consequent narrowing of their profits margin. The liberalisation of capital and international financial markets to all economic agents (firms and

households) meant that these agents could have access now to new, and sometimes cheaper, forms of funds. This led to large market-share losses for the banks. Big and financially strong companies started using their internal cash flows to finance their investments (lowering their dependence on bank loans). Unfair competition from government financial institutions which had better lending conditions. All these structural economic changes helped to deteriorate bank's profit margins and to narrow their market shares, contributing to a weaker financial system.

4.1.3.3. The Ever-Greening Problem

The so called "ever-greening problem", can be described as the phenomenon where the Japanese banks consciously continue to extend credit to insolvent borrowers where the prospects of being repaid are extremely doubtful (Hoshi and Kashyap, 2003). This behaviour artificially maintains inefficient firms in business and bars efficient new ones from entering the market, harming the productivity of the economy. Hoshi and Kashyap (2003) argue that this irrational behaviour happens due to strong pressures of the government, as, on one hand, the failure of these "zombie" firms would create more unemployment, and, on the other hand, banks want to hide the true situation of their customers and consequently also theirs.

4.1.3.4. Adverse Selection and Moral Hazard

In the past two decades Japanese banks have also been confronted with an adverse-selection problem, i.e. the quality and creditworthiness of bank loans has been declining, increasing bank credit risk. One of the causes for this problem lie with the fact that bigger and stronger firms have been able to save huge amounts of cash flows

which started to be channelled to their investments. Another cause is the financial liberalization of the domestic and international markets allowed for most credential and solid firms to get their financing from there. Only the smaller and weaker firms continued to depend heavily on bank loans boosting the risk faced by these institutions.

The profits and market shares loss faced by banks due to the process of deregulation, made them face some moral hazard situations. First of all, banks have been trying to overcome lower profit margins with riskier loans, using higher interest rates, but accepting a greater probability of default. An example of this behaviour was the increasing amount of loans given to risky real estate projects. Finally, with lower interest rates, banks have lost some incentive to continue the competent monitoring of their clients. Therefore, banks have been relaxing its monitoring facing a large risk due to their client's risky behaviour.

All these situations only made Japanese banks more fragile, since they are now facing greater risk and dangerous client behaviour.

4.1.3.5. Creation and burst of the twin bubble

In the mid 1980's, the Japanese yen appreciated more than expected, contributing to the slowdown of Japanese economic growth. As a result, political authorities decided to use an expansionist monetary policy, lowering interest rates to post-war lows and expanding money supply. This policy was allowed to continue for too long, overheating the Japanese economy. This fact alongside with the believe that stock and real-estate prices would never go down, and the ample and excess funds rushing from banks to finance real estate projects, created an speculative twin bubble in the stock and real estate

markets. Japan's Nikkei Stock Average rose from 6000 yen in 1980 to peak at 40.000 yen at the end of 1989 and land prices doubled from 1980 to 1991 (Hoshi and Kashyap, 2003).

In 1989, the MoF tightened its monetary policy, increasing the interest rates with the idea that it would be possible to gradually shrink the bubble until it disappeared. However what happened was its burst with a consequent steep decline in both the stock and real estate prices. In the first nine months of 1990 the Nikkei Average Stock lost 50% of its value and continued its loss through the 1990's. Real-estate prices had fallen to its 1980 values By 2003 (Hoshi and Kasyap, 2003). Consequently, a large number of firms and households started to experience great problems in paying their loans due to their loss wealth. Banks, already struggling with their own structural difficulties and weaknesses, were faced with an enormous amount of bad loans. The result was the collapse of the financial system with a huge non-performing loan (NPL) problem and some wide-spread bankruptcy.

Japanese banks suffered a severe shock with the burst of the bubble. They had a huge amount of loans in the real-estate sector and many of their clients used real estate as collateral. The values of NPLs were enormous. Fukao estimated a total cumulative value of 91.5 trillion yen (18% of the Japanese GDP in 2002) on NPLs between 1990 and 2003. Furthermore, the fact that almost all banks were extremely under-capitalized only worsened the scenario. A considerable list of bankruptcies occurred without the possibility of state-oriented mergers, in spite of their attempts to maintain the collusive bank bailouts. The NPL problem combined with the lack of capitalization of Japanese banks had two main consequences: (i) it created a credit crunch, as with all the bad

loans and bankruptcies the banks liquidity decreased dramatically and, consequently, loans had to be rationed. Therefore, less money was available to lend and that damaged the investment channel of the Japanese economy; (ii) it increased inefficiency in bank loans, since they tried to save themselves by lending to riskier "zombie" projects, always expecting rescue from the state in the case anything would go wrong.

4.1.3.6 Consequences of globalization

Patrick (1999) refers that globalization had also a strong role in Japan's financial mess. Moreover, this author argues that four important elements have contributed to the present situation. Firstly, Japan has become the largest creditor in the world due to its persistent current account-surplus. Therefore, Japanese financial institutions have engaged in foreign lending and portfolio investments exposing them selves to a massive exchange-rate risk. When the yen appreciated the losses were huge, almost in the same order of the NPL problem (Patrick, 1999). Second, as Japan has become a large country in the world markets, it now faces pressures and retaliatory measures by the U.S.A. or the E.U. Thus, it cannot export their way out of the crisis. Third, the flourishing of a free global capital market has increased the competition faced by the Japanese financial institutions, as the most solid firms would now obtain their funds abroad. Lastly, the deregulation process has allowed the installation in Japan of foreign banks which enhanced the competition in domestic financial markets.

It is clear that all these economic restrictions brought by the phenomenon of globalization has not only retarded Japan recovery, as it contributed decisively to the financial distress.

4.1.3.7 Financial technological inovation

Japanese banks have not been able to keep up the pace of technological innovation that blurred in the 1990's. That is a consequence of the way Main Bank System worked, as new products were prohibited for a long time, which did not allowed these banks to innovate. This system had clearly some characteristics that did not motivate banks to entail in more efficient forms of functioning. This collusive and promiscuous system stimulated the Japanese banks to keep their inefficient and non-innovating behaviour. The result was lack of capacity to adapt to the new forms of financial intermediation and consequent loss of competitiveness.

4.1.3.8 Some remarks

The persistence and deepness of the Japanese financial crisis make us believe that the burst of the twin speculative bubble only triggered the crisis. It cannot explain all the difficulties banks went through. The fact that these financial institutions did not seem able to overcome this distress, was clearly a result of structural deficiencies and handicaps brought in by the collusive, promiscuous, and opaque financial system built in the post war period. Therefore, if Japan wanted to return to financial stability it had to continue the reform packages with determination.

4.1.4. Possible Wedges arising from the Financial System Distress

4.1.4.1. Efficiency Wedges

The deep segmentation of the Main Bank System, where all type of banks had their specific market niches, implied that big and solid firms would obtain cheaper loans

from big banks and smaller businesses would obtain more expensive loans from smaller banks. Chari, Kehoe and Mcgrattan (2004) demonstrate in their paper that this kind of friction will always create an efficiency wedge since funds are applied not by efficiency criteria but by the company's size. This will produce an input misallocation and consequently an efficiency wedge.

The convoy bank system had two characteristics that gave birth to a pair of efficiency wedges. Therefore, the fact that banks are obliged to grow at the same pace drag back the more efficient banks originating a less efficient system. Second, inefficient banks were not allowed to fail and that had the obvious consequence of decreasing the overall efficiency of the Japanese banking system.

The lack of disclosure, transparency and the severe opaqueness of the main bank system due to collusive and promiscuous relations with the state implied that banks would lend money to firms that were not very creditworthy and efficient. Funds would be channelled to more inefficient firms instead of going to efficient ones, creating a misallocation of resources and consequently an efficiency wedge.

In the Japanese banking system large profits were guaranteed. Thus, banks did not have an incentive to enhance their efficiency and to cut costs creating more inefficiency.

Japanese state authorities putt pressure on banks to save their clients in financial distress, not permitting these to fail. This meant that, instead of lending their funds to new and more efficient firms, banks were spending their money in inefficient ones. The lost of efficiency is obvious originating an efficiency wedge.

The ever-greening problem, comprehensibly described above, also created an efficiency wedge hence inefficient "zombie" firms obtained funds that could be applied in new more efficient ones. Total factor productivity will undoubtedly diminish.

The burst of the bubble produced a very steep decline in stock and real-estate prices, resulting in an extreme financial distress where banks suffered a severe solvency problem due to the huge NPL phenomenon. Then, banks tried to save themselves through reckless and inefficient lending in an attempted to obtain higher interest rates. Therefore, inefficient enterprises obtained funds that otherwise would have gone to efficient ones breaking the overall economic efficiency. This originates an efficiency wedge.

4.1.4.2 Investment Wedges

The post-war financial system completely repressed capital markets not allowing Japanese firms to have access to cheaper financial sources. Therefore, these firms were forced to contract more expansive loans from banks, creating an implicit tax on investment. This in turn originates an investment wedge.

The burst of the bubble and its consequences gave birth to two investment wedges. First, the fall of the stock and real-estate prices made people poorer and consequently created deflation. Consequently, this deflation increased the real interest rate, leading to a raise in investment costs. Second, the NPL problem originated by the speculative bubble gave rise to a severe credit crunch on the Japanese financial market. With less

liquidity, investment funds became more expensive and harder to find, leading to more deflationary pressures and therefore to a higher real interest rate.

Finally, the strong yen appreciation caused banks capital losses at the same level of the NPL problem. As a consequence, it also strongly contributed to the credit crunch, since their liquidity decreased. Thus, less credit was made available which led to more expensive loans. This increase in the costs of investment generated an investment wedge.

4.2. Corporate Governance in Japan

Japan has a very unique and typical corporate governance system which is, in a way, a consequence of its cultural and social characteristics. This briefly analyses the Japanese type of governance, which evolved essentially after World War II, and then it explains the possible wedges (efficiency, labor and investment) that arose from it.

4.2.1 Post-War Corporate Governance

The Japanese style of corporate governance can be described using its core elements: (i) life-time employment system of management relations; (ii) enterprise unions; (iii) separation between ownership and management control; (iv) stable shareholdings; (v) Main Bank external finance; and (vi) supportive government policies and norms (Patrick, 2004). The most important of these features will be explained below.

4.2.1.1. Labor-Management Relations

Japanese corporations and managers see themselves as a community with responsibilities and obligations, in particular to its employees (Patrick, 2004). Therefore, the life-time employment system, where all employees have an almost (if not) 100% safety in the job, simultaneously, the seniority system was established, in which promotions and wages increases are based on age and not on merit.

The level of commitment of Japanese firms to their workers is enormous. Even when an economic recession strikes in, like it did in the 1990's, the lay-offs and the resulting unemployment are always the very last resource. Japanese managers prefer to continue with unproductive workers or to transfer them into associated firms, or even to force early retirement with special benefits. These measures are extremely harmful to business activity as they diminish its efficiency and raise its costs. Thus, managers favour their employees instead of their company's present and future competitiveness, i.e. instead of their shareholders interests.

4.2.1.2. Ownership and Control

It can be said that Japan is the most severe case of separation between ownership and control of companies. In this country, managers control and the ownership is, in the majority of cases, disseminated or inactive. This structure is one of great managerial independence and corporate governance strong norms of self-restraint, only partially constrained by its stakeholders, essentially their employees and creditors.

The management in this asian giant has two fundamental goals. The first is to preserve management autonomy in a self-selected, self-perpetuating system. The second is to

achieve the independent survival of the firm in perpetuity. Bankruptcy and mergers are seen as the worst possible outcomes. On the other hand, profit maximization has never been a top priority for Japanese managers and it is even seen as an anti-social, selfish behaviour. Indeed, in the 1990s, managers, when asked whose interest should be given primacy, inside stakeholders or shareholders, 97.1 per cent responded stakeholders (Patrick, 2004). By contrast, in the U.S. and in the U.K. only 24.4 per cent and 29.5 per cent, respectively, gave the same answer. Figure 1 shows it below.

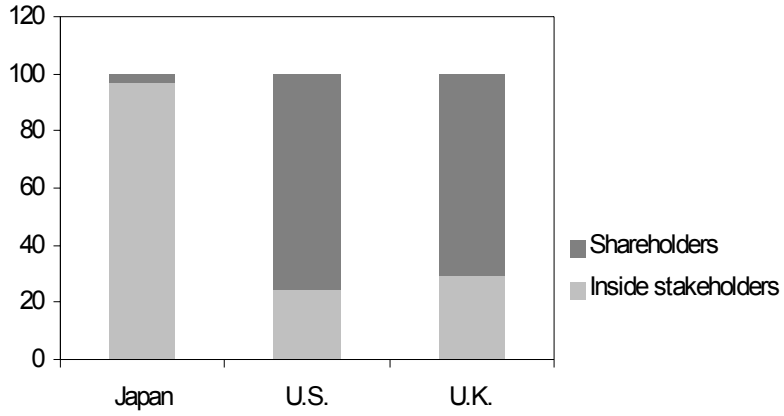

Figure 1 – Shareholders vs Stakeholders

4.1.2.3. Cross-shareholding

Manager's primary objective concerning shareholding was to make sure that a controlling interest was held by friendly firms (suppliers, customers, and mainly financial institutions), that would not intervene in the management process. This system is epitomized by the horizontal financial *keiretsu*, which is characterised by a vast and stable cross-shareholding among companies so as to reinforce the existing business

relationships. The outcome of this was a very obscure and promiscuous system which Hugh Patrick describes as:

> *"(...) a system of cozy back-scratching, some might say collusion, among the management of Japan's large industrial companies, financial institutions, and the government bureaucracies – particulary the Ministry of Finance (...) The system was opaque with minimal disclosure; forbearance was the policy stance (...)"*
>
> In Patrick (2004).

4.1.2.3. The of Role Banks

Bank financing was clearly the main financial source used by the Japanese firms in their investments in the past decades since World War II – mostly until the 1980's. This bank-firm relationship consisted in informal regular practices, institutional arrangements, and behaviours which formed a system of corporate finance and governance. In the finance distress point of this dissertation the banking system will be described more extensively.

4.2.2. System Overview and Recent Developments

The Japanese corporate government method, described above, worked reasonably well during the high-growth period. Hence, this prosperity hided all its errors and difficulties. But, when the crisis arrived it became obvious that this system would have to be changed in order to allow for the Japanese economy to recover.

Therefore, some transformation occurred in the Japanese management system. First, some government-led measures were taken to enhance its flexibility (e.g. mergers, re-organizations, spin-offs), disclosure, and transparency. The pattern of shareholding has

also changed. Most importantly, some shareholder activism is now possible for the first time. Shareholders can have a greater impact on management. Investments can be financed more heavily by the capital markets and other financial instruments in bank's detriment. The permanent employment and seniority system is slowly and weakly being challenged by the rise in the unemployment and meritocracy.

Although all this changes started to occur at the beginning of the new century, a lot is still to be done. The vested interests of the Japanese bureaucracy blocks the more aggressive, audacious, and most needed reforms in the corporate government system, undermining Japan's economic growth.

4.2.3. Possible Wedges in Corporate Governance

4.2.3.1.Efficiency Wedges

The life-time employment system can undoubtedly create an efficiency wedge given that it keeps a person on a job, without monitoring their productiveness, implying a misallocation of inputs. The seniority system also produces an efficiency wedge, as more productive younger workers may start to put less effort since they are not compensated for their merit. This lowers productivity and consequently leads to an efficiency wedge.

Managers are very attached to their employees. They do not use lay-offs when they should, preferring to irrationally maintain unneeded and unproductive workers or to transfer them to other firms where they will be completely redundant. An efficiency wedge surely rises from this behaviour. The extreme separation between ownership and

control gives a great deal of power to the Japanese managers. Thus, a principal-agent problem exists, where those managers tend to undertake many investment projects regardless of their profitability of productivity. For that reason, some inputs will be misallocated originating an efficiency wedge.

The last efficiency wedge comes from the stable cross-shareholding and strong embedded relations that exist between Japanese firms and their suppliers. This is true because even when a supplier is inefficient and unproductive, his client can't break the existing relation between them to switch to a new more efficient supplier. This clearly creates an efficiency wedge.

4.2.3.2. Labor Wedges

As has been said above, the Japanese corporate governance through its strong cross-shareholding and close ties between their firms, financial institutions (vertical and horizontal *keiretsu*), and even with the government and its bureaucracy, give space to the occurrence of some monopoly and cartel behaviour. Chari, Kehoe and Mcgrattan (2004) say that this kind of conduct leads to a labor wedge.

4.3. Dualist Economic System

Japanese industrial development policies in the post-war era led to the creation of a dualist economy. The Japanese government supported, through investment and incentive policies, the expansion of a multi-national export-oriented sector that is highly efficient and modern. This sector is best represented by the automobile and electronics

industry. In the meantime, however, it has also created an extremely inefficient import-averse sector, where these industries are heavily regulated and protected from competition both domestic and foreign. Some primary industries (e.g. agriculture), service industries (such as transportations, telecommunications, retailing, finance and others) and manufacturing industries (food and beverage) constitute this sector.

There are two important facts to be reported about this phenomenon in the Japanese economy. The first is that the ever-growing trade surplus and consequent yen appreciation brought by the export oriented sector have putted an immense pressure on the import-adverse sector, as these goods became cheaper. This sector needed some efficiency improvement as well as an opening to competition and imports. Nevertheless, the Japanese authorities continued with their severe protectionist policy, not allowing this sector to enhance its productivity or to import cheaper products. The cost was a bigger efficiency gap between the two sectors and a price discrimination against domestic consumption. The second is that the two structurally differentiated sectors are not completely independent of each other. They are interconnected in a multiplicity of ways, mainly within the big *keiretsu* where the inefficient sector provides many services or even some inputs.

Then, the existence of this dual structure in Japan creates some inefficiency problems and punishes Japanese consumers with higher prices that otherwise would not exist. The main reason appointed for the maintenance of this reality is the vested and promiscuous interests of the bureaucrats and the political party in power, namely the Liberal Democratic Party (Ozawa, 2004).

4.3.1 Possible Wedges

4.3.1.1. Efficiency Wedge

The maintenance of a dualist economic structure by the public authorities and its bureaucracy with one very productive sector and one very inefficient sector will surely lead to a misallocation of inputs and to a more inefficient economy. The lost of efficiency resulting from this phenomenon will give rise to an efficiency wedge.

4.3.1.2. Labor Wedge

One of the consequences of this dualist reality is the higher prices that Japanese consumers are forced to pay due to the strong protectionism. Thus, this can be seen as an implicit tax on the population's income and so it can possibly induce to a labor wedge.

4.4 Saving surplus, over-capacity and over-employment

During its catch up process in the post war period, Japan has defined it-self has a high-saving, high-investment and low-consumption economy. In those times this worked well because the Japanese growth was so strong and the investment opportunities were so big that all the savings were used in a very productive way. However, as the catch-up process ended and economic growth slowed down by the late 1970s, investment opportunities started to decrease. The Japanese economy was changing to a high-saving medium-investing, low-consumption profile, hence savings continued to be very large and consumption very low. With the burst of the twin bubbles and the consequent

economic and financial crisis, this problem became even worse because investment opportunities fell even further and the investment channel collapsed.

This macroeconomic feature was extremely harmful for the Japanese economy since it appears as an insufficient aggregate demand and a huge saving-investment gap (Patrick, 2002). The outcome was a deterioration of the deflationary spiral that hindered the recovery of the Japanese economy, an unprecedented monetary ease and excess liquidity and an enormous government debt (over 140% of the GDP). The excess savings, hence a good thing, turned into a negative feature, as financial capacity not being used in a productive way. It was now a burden.

Usually economic theory says there are three possible ways of overcoming a situation like the previously described. One way is to increase investment profitability and opportunities through structural reforms enhancing effective competition and flexible markets. A second course of action is to stimulate consumption and decrease the amount of savings using both fiscal and monetary policies. As we are going to see later in this dissertation, the instruments have not been applied as they should in Japan. A third and final approach is to export its crisis rest of the world, increasing its current account surplus. The problem with this method is the fact that Japan is considered a large country in international trade and as a consequence of this, it is always under pressure from the E.U. and the U.S.A, that are not willing to accept a further increase in the Japanese surplus. Thus, it seems that Japan's way out of this macroeconomic slump is to entail in deep structural reforms and strong economic policies to increase investment opportunities and consumption.

This economic crisis was also an overcapacity one where aggregate supply largely overcame the existent aggregate demand. A cause of this feature was a clear over-employment situation where firms, pressured by the government and its cultural heritage do not close down inefficient firms and subsidiaries keeping a large number of unproductive and unnecessary employees (labor hoarding). This excess supply pressured prices down, contributing to increase the deflationary spiral. On the other hand, the reluctance or even denial in firing inefficient and excess employees will clearly artificially keep unproductive companies in business, and that will diminish the economy's efficiency.

Therefore, Japan had to allow some market adjustment and the failure of the "zombie" firms permitting the existence of some unemployment, as this will help a future sustainable economic recovery since new more efficient firms may substitute the inefficient ones. Nevertheless, Japan had also to work on the demand side implementing fiscal and monetary packages to stimulate consumption and investment.

4.4.1. Possible Wedges

4.4.1.1. Efficiency Wedges

The efficiency wedge is related to total factor productivity break down brought by the non closing policy existent in Japan regarding weak inefficient firms and unproductive workers. This sourly will lead to an input misallocation and consequently to an efficiency wedge.

4.4.1.2 Investment wedge

The existence of enormous savings surplus and an inadequately low aggregate demand push prices down originating more deflationary pressures. This will increase the real interest rate and conduce to an investment wedge.

The excess supply present in the Japanese economy as a consequence of overcapacity obviously lowers the market prices, and increases both deflation and real interest rates. This way investment becomes more expensive creating an investment wedge.

4.5. Government policy mismanagements and bureaucrats vested interests

In this section some features related with government and state performance are described. Some policy mismanagements that contributed considerably to Japan's past situation and the vested interests of powerful bureaucrats will be exposed.

4.5.1. Government Policy Mismanagements

Macroeconomic policy, both in fiscal and monetary areas, errors made by the Japanese government in the past decade has turned it more difficult to overcome the economic and financial crisis. The first error was the policy used to respond to the yen appreciation in the 1980's. When trying to react to the yen-induced recession, monetary authorities lowered their interest rates to post war lows in an attempt to boost economic growth. The problem was they kept this policy for to long, overheating the economy and creating the real-estate and stock market bubbles. As we know, the subsequent

tightening of the monetary policy resulted in the burst of the bubble and in the economic and financial distress of the past fourteen years.

The next policy mistake consisted in not applying an expansionary monetary and fiscal policy sooner and more forcefully in the first years of the 1990's. In the early stages of the depression, public authorities saw this crisis mainly as a downturn in a normal business cycle, underestimating both the severe structural problems of the Japanese economy and the profound effects of the brutal decrease in asset values, i.e., the perception was that this distress would be short-leaved and the economic recovery would began rapidly. Hence, all this policy lethargy just helped to aggravate the crisis.

The third slip-up is of monetary nature and it is related to the fact that, in the late years of the 1990's and in the first years of the new millennium, many monetary policy mistakes have been produced by the Bank of Japan (BoJ), leading to an increasing deflationary pressure. In general the BoJ's course of action was too weak and dubious. It never implemented a really strong and determined policy to end deflation and to create some inflation. Only by 1999 the zero interest rate policy (ZIRP) was put in practise and very timidly, as the central bank argued it would not be working for too long. This obviously erased the possible positive effects that this policy would have had in expanding domestic demand. Moreover, in 2000, when some weak positive signs on the economy were visible, the BoJ ended the ZIRP policy which immediately led to a cool-down of the Japanese economy. This is only one example of the bad monetary policy applied in Japan. Japanese authorities were more worried with possible inflation that could arise from their policies when their economy was still suffering from an

extreme deflationary spiral. All these mistakes contributed to weaken domestic demand encouraging even more the deflationary pressures.

The fourth macro policy mismanagement can be identified, in the fiscal area, and it is related to the fact that supplementary budgets of the 1990's have been applied "(…) to little, too late, and most important, too grudgingly" (Patrick, 1999). Japanese fiscal packages did not inspire any confidence in economic agents because they were presented as temporary and incorporated offsetting policies which made them look ambiguous at the eyes of the private sector. This lack of credibility would, obviously, decrease their effectiveness and usefulness. More, the "real water" (real effective and productive fiscal incentives) that these fiscal budgets contained, was always less than it was claimed by the public authorities. So, the Japanese fiscal policy was also too confused and it had little real stimuli.

The fifth mistake was a dreadful government decision, in late 1996, as a consequence of excessively optimistic economic forecasts for 1997 and beyond. At the end of 1995, a supplementary budget had become effective and was producing some economic recovery at last. By 1996, the Japanese policy authorities, instead of letting that stimulus continue until a consistent economic growth was achieved, took restrictive fiscal measures with the objective of reducing their deficit. This policy consisted in a consumption-tax rise and a fiscal-law reform that produced steady decreases in future government budgets. The aftermath was a steep reduction in domestic demand (over 2 percentage points of their GDP according to Patrick, 1999) and stalled the economy, where with a GDP fall of 0.7 per cent in 1997. Again, all these mistakes only made worse the economic crisis and its deflationary spiral.

As it can be seen, the Japanese economic policy was everything but accurate. Both in monetary and fiscal terms, their measures were almost always too weak, too late, and exhibited several changes in direction that had the perverse effect of decreasing their own effectiveness and credibility. In order to escape such a deep crisis, monetary and fiscal policies need to be strong determined and require a clear and straight path. That is what the Japanese authorities needed to entail.

4.5.2. Bureaucrats Vested Interests

The magnitude of the Japanese economic crisis requested a huge amount of deep and consistent reform packages in almost all economic sectors and even more in the inefficient ones. Furthermore, these reforms would clearly hurt some strong vested interest groups in the Japanese society. Thus, these groups of bureaucrats, representing the inefficient part of the economy, started to lobby against big structural changes that might hurt them. Their power was and still is very large since they are one of the main forces that provide votes and money to the LPD. Consequently, they began to draw back some important actions that would help Japan moving out of the economic malaise. It is consensual that one of the main reasons for the persistence of the Japanese crisis is the lack of political determination to take correct measures, which is the outcome of pressure made by some vested interest groups.

4.5.3 Possible wedges

4.5.3.1. Efficiency Wedge

As it has been argued above, bureaucrats have tried to prevent the structural reforms Japan needed in order to overcome its depression as these would seriously damage their

inefficient sectors. Therefore, this group of interests, by lobbying against reform is not allowing many inefficient segments of the Japanese economy to shut down. This certainly decreases the total factor productivity creating an efficiency wedge.

4.5.3.2 Labor Wedges

Chari, Kehoe and Mcgrattan (2004), demonstrate that monetary policy shocks combined with wage stickiness induce the formation of a labor wedge. As we know, monetary shocks in Japan were plenty in the past decade and wage rigidity is an observed fact as well. Therefore, a labor wedge arises from the combination of these two realities in Japan.

4.5.3.3 Investment Wedges

The overall conduct of the Japanese economic policy – fiscal and monetary – has been poor. It has been too weak, too late and ambiguitous. Thus, the lack of a determined, strong, and straight-forward economic policy has helped to increase the stagnation or even the deterioration of the Japanese domestic demand with obvious consequences of increasing the deflationary spiral. This means that the Japanese public authorities contributed to a rise in the real interest rate leading to an investment wedge.

5. Business Cycle Accounting: a detailed explanation

In this dissertation I use the business cycle accounting technology developed in Chari et al. (2004). There, the authors present a novel method that helps researchers to find classes of models with various frictions that can express, quantitatively, the economic

fluctuations, in a better way. This methodology has an equivalence result and an accounting procedure.

5.1 The equivalence result

In this specific technology, a large group of models with several different frictions are equivalent to a prototype growth model with dynamic wedges that look like time-varying productivity, labor taxes, and investment taxes. Thus, this time varying wedges are labelled as efficiency wedge, labor wedge, and investment wedge.

The theory behind this method is the well known idea that frictions that resemble taxes distort the relation between various marginal rates. As an illustrative example, that will be seen later, taxes in labor distort the intertemporal marginal rate of substitution, between consumption and labor, from the labor marginal product, and consequently creates a labor wedge. Also, taxes in investment distort the intertemporal marginal rates of substitution and the intertemporal marginal rates of transformation, producing an investment wedge. In the same way, taxes on intermediate goods cause inefficiencies in the production leading to an inefficiency wedge.

Numerous models map into a similar configuration of wedges, thus, choosing a particular configuration does not identify a single model, but rather it identifies a whole class of models. Thus, this methodology tries to show us what kind of frictions can best describe the business-cycle fluctuations in the economies we want to analyse. It provides guidance on what classes of frictions should be introduced in a particular model to successfully describe economic fluctuations in that economy.

5.2 Model frictions and wedges

In this section I present and describe a large number of frictions which, according to Chari et al. (2004), map into efficiency wedges, labor wedges, and investment wedges. Notice that one friction can produce more then one wedge, for example, Chari et al. (2004) argues that input-financing frictions distort all three wedges.

5.2.1 Efficiency wedges

Chari et al. (2004) argue that the prototype model with an efficiency wedge is equivalent to a large class of models with different frictions. More precisely, it is stated the equivalence between this prototype model and economies with: (i) constant technology but where input-financing frictions vary over time; (ii) within-firm frictions resulting from work rules as in Schmitz (2001); (iii) monetary shocks in the presence of nominal rigidities; (iv) government policies; and (v) moral hazard in financial markets. This means that models with this sort of frictions can lead to aggregate product inefficiency mirrored in the prototype economy by the efficiency wedge. However, this paper also states that, besides these ones, all the economic frictions that leads to total factor productivity break down creates an efficiency wedge.

5.2.2 Labor Wedge

Also, it can be proved the equivalence between the prototype model with a labor wedge and models with: (i) sticky wages and monetary shocks, as in Bordo et al. (2000); (ii)

unions and antitrust policy shocks; (iii) cartelization theories; (iv) monopoly power exerted by firms and unions; (v) government policies; (vi) input financial frictions. This means that some economies with this kind of distortions produce a form of labor tax that resembles the labor wedge of the prototype economy. Once again is also argued that any friction resulting in a labor tax will originate a labor wedge.

5.2.3 Investment wedge

Finally, Chari et al. (2004) demonstrate there exists a found equivalence between the prototype economy with an investment wedge and models with: (i) credit-market frictions as in Bernanke and Gertler (1989) and Carlstom and Fuerst (1997); (ii) monetary shocks; (iii) government policies; (iv) costly state verification; and (v) input financial frictions. This implies that models with this sort of disturbances give rise to an increase in investment costs that are equivalent to the investment wedge of the prototype economy. More generally, all the frictions that give birth to a tax on investment will produce an investment wedge.

It is essential to notice that, in business cycle accounting, it is not important if a particular wedge exists or not, but its fluctuations overtime.

5.3 The Prototype Growth Model

For the construction of the prototype economy I follow closely both Chari et al. (2004) and Chakraborty (2004). The final aim is to identify which wedges are more important

in explaining the cyclical fluctuations in the post-bubble-burst period. This method is able to propose what classes of models are more accurate in reproducing the Japanese economic crisis. In the next chapter the outcomes at the simulation procedure will be used to identify the most promising explanations advanced in recent literature.

The benchmark prototype model that will be used to account for the "Japanese lost decade" is a growth model with three stochastic variables: the efficiency wedge A_t, the labor wedge ($1-\tau_{lt}$) and the investment wedge $1/\left(1+\tau_{x_t}\right)$. In each period the economy consists on N_t identical agents. The representative household chooses per capita consumption c_t, per capita investment x_t, and per capita labor l_t as to solve the following maximization problem:

$$\begin{aligned} &\max_{c_t, x_t, l_t} E_0 \sum_{t=0}^{\infty} N_t.\beta^t.u(c_t, 1-l_t) \\ &s.t. \qquad c_t + \left(1+\tau_{x_t}\right).x_t = \left(1-\tau_{l_t}\right).w_t.l_t + r_t.k_t + T_t \\ &\qquad\quad N_{t+1}.k_{t+1} = \left[\left(1-\delta\right).k_t + x_t\right].N_t \\ &\qquad\quad c_t, x_t \geq 0, \text{ in all states,} \end{aligned} \tag{1}$$

where k_t denotes the per capita capital stock, w_t the wage rate, r_t the rental rate on capital, β the discount factor, δ the depreciation rate for capital, and T_t is a lump-sum tax. The first constraint is the intratemporal budget constraint and the second represents the aggregate capital-accumulation identity.

A representative firm uses capital and labor to produce the final good. The firms production function is given by $A_t.\mathrm{F}(k_t,(1+g_z)^t.l_t)$, where $(1+g_z)^t$ is labor-augmenting technical progress that is assumed to evolve at a constant rate. Firms maximize their

profits choosing the per capita labor l_t and per capita capital k_t, both implied by households, that solves:

$$\begin{aligned} &\max_{k_t, l_t} A_t.F\left[k_t, (1+g_z)^t.l_t\right] - r_t.k_t - w_t.l_t \\ &s.t. \qquad N_t.y_t = A_t.F\left[K_t, (1+g_z)^t.L_t\right] \\ &\qquad y_t \geq 0, \forall t \geq 0 \end{aligned} \tag{2}$$

where y_t stands for aggregate per capita output. The government sets its taxes and transfers such as its budget constraint

$$N_t.g_t + T_t = N_t.(\tau_{l_t}.w_t.l_t + \tau_{x_t}.x_t), \tag{3}$$

is satisfied. In this equation g_t stands for government consumption. Furthermore, it is assumed that the government spending is wasted every period and does not enter in the representative agent's utility function. Since the representative household is infinitely living, ricardian equivalence holds, thus we can ignore government borrowing in its budget constraint.

In equilibrium the following conditions must hold:

$$N_t.(c_t + x_t + g_t) = N_t.y_t = A_t.F\left[K_t, (1+g_z)^t.L_t\right] \tag{4}$$

Note that in the following first order conditions any detrended variable v_t^* is given by:

$v_t^* = v_t/(1+g_t)^t$, i.e. a variable v_t discounted by the long-term growth rate of technological development.

The first order conditions for the pair of maximization problems presented before give rise to the following equations:

$$A_t = \frac{y_t}{F\left[k_{t,}(1+g_z)^t.l_t\right]} \tag{5}$$

$$-\frac{U_{l_t}}{U_{c_t}} = (1-\tau_{l_t}).A_t.F_{l_t} \tag{6}$$

$$U_{c_t}.(1+\tau_{x_t}) = \beta.E_t U_{c_{t+1}}[A_{t+1}.F_{k_{t+1}} + (1-\delta).(1+\tau_{x_{t+1}})] \tag{7}$$

$$c_t + x_t + g_t = y_t \tag{8}$$

where, U_l is the marginal utility of labor; U_c is the marginal utility of consumption; F_l is the labor marginal product; and, F_k is the capital marginal product.

Thus, given the state of the economy by the wedges, $\mathbf{S_t} = (A_t, \tau_{l_t}, \tau_{x_t}, g_t)$, and by the per capita capital stock k_t it is possible to obtain the recursive laws of motion for the decision variables:

$$y_t = y_t(\mathbf{S_t}, k_t) \tag{9}$$

$$c_t = c_t(\mathbf{S_t}, k_t) \tag{10}$$

$$l_t = l_t(\mathbf{S_t}, k_t) \tag{11}$$

$$k_{t+1} = k_{t+1}(\mathbf{S_t}, k_t) \tag{12}$$

Note that from now on government consumption will be considered as a wedge.

5.4 The accounting procedure

In the accounting procedure the preference's parameters of the prototype model are chosen as in the standard quantitative business-cycle literature. Then, the data and the equilibrium conditions of the prototype model are used together to obtain the time series for the four wedges. In the following step, these values of the wedges are fed back to the model, either isolated or in combinations, so we can weigh up the fraction of output, labor, and investment movements that can be attributed to each wedge individually and to the various combinations of them. The role of the wedges is quantified by comparing the realizations of variables like output, labor, and investment from the model to their data values. Note that all four wedges put together account for all the observed movements in output, consumption, investment, and employment, which is what makes this method an accounting procedure.

5.4.1 Measuring the wedges

5.4.1.1 Working the data

The data is used in the accounting procedure to estimate the stochastic process for the wedges and then measure the realized wedges once the parameters of the stochastic process are known (Chakraborty, 2004). The period use in the data is the same as in Chakraborty (2004), i.e. from 1980 to 2001. Likewise, it is assumed that in 1980 the Japanese economy was on its balanced growth path. The data used is of annual frequency, and values are expressed in 1995 constant prices in Japanese yens, taken from the AMECO data base from European Commission (2004). The population considered N_t is the population aged between 15 and 64. Labor supply corresponds to

total hours worked in each year, and values are obtained by adding monthly taken from OECD (2004).

Some accounting conventions were used. The investment X_t is the sum of the gross fixed-capital formation and the change in inventories. Our aggregate consumption C_t is calculated adding the net exports. This is not the only way of dealing with an open-economy reality in this closed-economy set up. However, this was the choice in Chari et al. (2004), Chakraborty (2004), and in Kobayashi and Inaba (2005). Using the same convention facilitates comparing the results with existing literature.

The capital stock series is calculated using the capital formation equation, $k_{t+1} = x_t + (1-\delta).k_t$. The initial capital stock, k_0, is assumed to be its Japanese value in 1980.

5.4.1.2 Estimating the wedges

The process of measuring the wedges consists in two steps: (i) an estimation of the stochastic process for the wedges is done; and (ii) the realized wedges are obtained. We use it to estimate the efficiency wedge, the labor wedge, and the investment wedge. The government wedge is taken directly from the data. Having all the data needed and the model's parameters we can use equations (5) to (8) to generate values for the wedges. The efficiency wedge is directly given by equation (5) and the labor wedge by equation (6). The investment wedge is calculated directly from equation (7), since we assume the existence of perfect foresight. The future values become deterministic. Without this assumption it would be impossible to obtain the investment wedge directly from the data, as it would depend on expectations over future values of consumption, capital stock, wedges, and others. The

decision rules of the model in question would depend on this expectations and thus on the stochastic process driving the wedges.

As it is mentioned above, without assuming the perfect foresight hypothesis it would be impossible to calculate the investment wedge directly from equation (7), as this would depend on expectations over future values of some variables, which are unknown. Chari et al. (2004) and Chakraborty (2004) present two alternative ways of overcoming this problem. In Chari et al. (2004) the investment wedge is generated through a kalman filter and the stochastic process for the wedges is estimated applying a Maximum Likelihood Estimation. In Chakraborty (2004), the investment wedge is produced, and the stochastic process is estimated through an iterative process between model simulations and SVAR estimations. However, Kobayashi and Inaba (2005) apply the business cycle technology to Japan using the perfect foresight assumption.

The first two methods may have the advantage of producing more accurate estimations, but have against it the fact that what we gain in accuracy may not compensate the extreme complexity of its computation. The third method may produce estimations with less accuracy, but it is simpler to compute. I have chosen this method for the sake of simplicity and following Kobayashi and Inaba (2005), when they argue that the perfect foresight method is almost as accurate as the other two. Nevertheless, I will test in the future the robustness of this technology results with respect to the estimation method used, or its parameterization sensibility.

To estimate the above-mentioned wedges the following specific functional forms and parameter values taken from the business-cycle literature are used. It is assumed the

production function is Cobb-Douglas with constant returns to scale $A_t.F[k_t,(1 + g_z)^t.l_t] = A_t.k_t^{\theta}.[(1 + g_z)^t.l_t]^{1-\theta}$. The felicity function is additively separable and is logarithmic, i.e. it is given by $u(c, 1 - l) = \log c + \psi \log(1 - l)$[1]. The parameters values are taken from Prescott and Hayashi (2002). They chose $\theta = 0.36$, i.e. a labor-share of 64 per cent of national income; $\beta = 0.972$, i.e. a discount factor of 2.9 per cent per year; $\delta = 0.089$, i.e. a depreciation rate of 8.9 per cent per year; $\psi = 1{:}13$. The time endowment is of 5000 hours per annum.

Now, using the utility and the production functions we can obtain the following expressions for equations (5) to (8):

$$A_t = \frac{y_t^*}{\left(k_t^*\right)^{\theta}.\left[\left(1+g_z\right)^t.l_t\right]^{1-\theta}} \tag{13}$$

$$\frac{\psi}{1-\theta}.\frac{c_t^*}{y_t^*}.\frac{l_t}{1-l_t} = 1-\tau_{l_t} \tag{14}$$

$$\frac{\left(1+\tau_{x_t}\right).\left(1+g_z\right)^t}{c_t^*} = \beta.E_t\left\{\frac{1}{c_{t+1}^*}.\left[\theta.\frac{y_{t+1}^*}{k_{t+1}^*}+\left(1-\delta\right).\left(1+\tau_{x_{t+1}}\right)\right]\right\} \tag{15}$$

$$c_t^* + g_t^* + \left(1+g_z\right).\left(1+g_n\right).k_{t+1}^* - \left(1-\delta\right).k_t^* = y_t^* \tag{16}$$

Where g_n is the constant growth rate of the population.

[1] In this case we are assuming the elasticity of intertemporal substitution in both consumption and leisure are equal to unity.

The next step is to obtain the stochastic process for the wedges. Since we have the data on y_t, c_t, l_t and x_t we can obtain g_t directly from the data. The efficiency wedge A_t, the labor wedge $(1-\tau_{l_t})$, and the investment wedge $1/(1+\tau_{x_t})$ are calculated from equations (13), (14) and (15), respectively. With all the values of the wedges we can now obtain the solution for the recursive laws of movement for the model.

In order to do that, the model is log-linearised about its steady-state, using the method described in King et al (1989). To complete the process the method of undetermined coefficients is used to obtain a solution for the log-linearised recursive laws of motion. Notice that if there were no shock on the wedges the economy would always be on its balanced-growth path with the per capita values of consumption, output, and investment growing at rate g_z, and employment would be constant over time. Consequently, to solve for the steady state it is needed to discount all variables on the balanced growth path by their balanced growth path rate g_z (Chakraborty, 2004). This is done in equations (13) to (16) by using the detrended values of the variables.

Let us now use equations (13) to (16) to compute the steady state values for the detrended variables. Note that from the corresponding steady-state equations below we can also obtain the steady-state values for all the other variables. The year of 1980 is considered to be the steady-state where consumption c_t, output y_t, investment x_t, capital stock k_t, and employment l_t are at their initial values, i.e. the detrended 1980 values for these variables are then taken as their

steady state values. Thus, the steady-state equations solving for the wedges are given by:

$$A_{1980} = \frac{y_{1980}}{k_{1980}^{\theta}.\left(l_{1980}\right)^{1-\theta}} \tag{17}$$

$$1-\tau_l = \frac{\psi}{1-\theta}.\frac{c_{1980}}{y_{1980}}.\frac{l_{1980}}{1-l_{1980}} \tag{18}$$

$$1+\tau_x = \beta.\theta.\frac{y_{1980}}{k_{1980}}.\frac{1}{1-\beta.\left(1-\delta\right)} \tag{19}$$

$$c_{1980} + g_{1980} + \left(1+g_z\right).\left(1+g_n\right).k_{1980} - \left(1-\delta\right).k_{1980} = y_{1980} \tag{20}$$

Now, the systemis log-linearized about its steady state, in order to obtain the laws of motion:

$$\tilde{A}_t = \tilde{y}_t^* - \theta.\tilde{k}_t^* - \left(1-\theta\right).\tilde{l}_t \tag{21}$$

$$-\frac{\overline{\tau}_l}{1-\overline{\tau}_l}.\tilde{\tau}_{l_t} = \tilde{y}_t^* - \tilde{c}_t^* - \frac{1}{1-\overline{l}}.\tilde{l}_t \tag{22}$$

$$\begin{aligned}&\beta.\theta.\frac{\overline{y}}{\overline{k}}.E_t\left(\tilde{y}_{t+1}^* - \tilde{k}_{t+1}^*\right) + \beta.\left(1-\delta\right).\overline{\tau}_x.E_t\tilde{\tau}_{x_{t+1}} - \\ &-\beta.\left[\theta.\frac{\overline{y}}{\overline{k}} + \left(1-\delta\right).\left(1+\overline{\tau}_x\right)\right].E_t c_{t+1} = \left(1+g_z\right).\overline{\tau}_x.\tilde{\tau}_{x_t} - \left(1+g_z\right).\left(1+\tau_x\right).\tilde{c}_t\end{aligned} \tag{23}$$

$$\overline{y}.\tilde{y}_t = \overline{c}.\tilde{c}_t + \left(1+g_n\right).\left(1+g_z\right).\overline{k}.\tilde{k}_{t+1} - \left(1-\delta\right).\overline{k}.\tilde{k}_t + \overline{g}.\tilde{g}_t \tag{24}$$

where any variable $\tilde{z}_t = (z_t - \bar{z})/\bar{z}$ and $\bar{z}$ is its steady state value. The next step is to specify a stochastic process for the wedges, more precisely, a vector autoregressive process (VAR1). If we define a vector $\mathbf{S}_t = [\tilde{A}_t, \tilde{\tau}_{l_t}, \tilde{\tau}_{x_t}, \tilde{g}_t]$, the VAR1 process is given by $\mathbf{S_{t+1}} = \mathbf{P}_0 + \mathbf{P}.\mathbf{S}_t + \mathbf{Q}.\mathbf{E_{t+1}}$ and where ε_{t+1} is normal and i.i.d. and **Q** is a lower triangular matrix.

The parameters of this stochastic process are very important, as the parameters of the recursive laws of motion depend directly on them. Therefore, the next step in the accounting procedure is to find $\mathbf{P_0}$, **P**, and **Q**. This is done simply by estimating the VAR with a Cholesky decomposition. With the values of $\mathbf{P_0}$, **P**, **Q**, and the stochastic process of the wedges the parameters of the recursive laws of motion of the model can now be calculated.

5.4.1.3 Decomposition

The model's measured realizations are used to decompose movements in variables from an initial date (1980), given an initial capital stock, into the four components consisting of movements driven by each of the four wedges away from their initial values at the initial date (Chari et al., 2004), assuming all the others stay at their steady state values, e.g. the efficiency component will be presented as $\tilde{\mathbf{S}}_{\mathbf{t}}^{\mathbf{A}} = [\tilde{A}_t, 0, 0, 0]^T$. Other components can be defined in a similar fashion. Now, using these components and the initial period capital stock, k_{1980}, we can calculate the capital-stock series from $\tilde{k}_{t+1} = \tilde{k}_{t+1}(\tilde{\mathbf{S}}_{\mathbf{t}}^{A}, \tilde{k}_t)$. Note that $\tilde{k}_{t+1} = \tilde{k}_{t+1}(\tilde{\mathbf{S}}_{\mathbf{t}}^{A}, \tilde{k}_t)$ is the estimated recursive law of motion of the capital-stock. Then, applying both $\tilde{\mathbf{S}}_{\mathbf{t}}^{A}$, the estimated capital-stock series, and the recursive laws of motion obtained for the decision variables, we can reproduce the movements in the

decision variables of the model that can be attributed to the efficiency wedge. Thus, we obtain a set of equations for the log-deviations of the key variables:

$$\tilde{y}_t = \tilde{y}_t\left(\tilde{\mathbf{S}}_{\mathbf{t}}^{\mathbf{A}}, \tilde{k}_t\right) \tag{25}$$

$$\tilde{c}_t = \tilde{c}_t\left(\tilde{\mathbf{S}}_{\mathbf{t}}^{\mathbf{A}}, \tilde{k}_t\right) \tag{26}$$

$$\tilde{l}_t = \tilde{l}_t\left(\tilde{\mathbf{S}}_{\mathbf{t}}^{\mathbf{A}}, \tilde{k}_t\right) \tag{27}$$

$$\tilde{k}_{t+1} = \tilde{k}_{t+1}\left(\tilde{\mathbf{S}}_{\mathbf{t}}^{\mathbf{A}}, \tilde{k}_t\right) \tag{28}$$

To obtain the movements in the decision variables due to other wedges, the same procedure is repeated, considering the appropriate wedge.

We can also compute the model using joint components, i.e. two or more wedges simultaneously. As an example, a joint component with the efficiency and the investment wedge is given by $\mathbf{S}_{\mathbf{t}}^{\mathbf{A},\mathbf{x}} = [\tilde{A}_t, 0, \tilde{\tau}_{x_t}, 0]^T$. Thus, we obtain four simple wedge components, six dual components ($\mathbf{S}_{\mathbf{t}}^{\mathbf{A},\mathbf{l}}$, $\mathbf{S}_{\mathbf{t}}^{\mathbf{A},\mathbf{x}}$, $\mathbf{S}_{\mathbf{t}}^{\mathbf{A},\mathbf{g}}$, $\mathbf{S}_{\mathbf{t}}^{\mathbf{l},\mathbf{x}}$, $\mathbf{S}_{\mathbf{t}}^{\mathbf{l},\mathbf{g}}$, and $\mathbf{S}_{\mathbf{t}}^{\mathbf{x},\mathbf{g}}$), and four more triple components ($\mathbf{S}_{\mathbf{t}}^{\mathbf{A},\mathbf{l},\mathbf{x}}$, $\mathbf{S}_{\mathbf{t}}^{\mathbf{A},\mathbf{l},\mathbf{g}}$, $\mathbf{S}_{\mathbf{t}}^{\mathbf{A},\mathbf{x},\mathbf{g}}$, and $\mathbf{S}_{\mathbf{t}}^{\mathbf{l},\mathbf{x},\mathbf{g}}$).

To account for the part of the output, investment or employment those different wedge components can explain, the model is simulated using the realized sequence of wedges separately and in combinations. After this, the realizations of these variables from the model simulations are simply compared to the data.

5.4.2 Accounting results

In this sub-section the outcomes from applying the business-cycle accounting procedure to the Japanese case between 1980 and 2001, are presented and analysed. First, let us observe the evolution of variables like GDP or investment in Japan. Then, we will present the wedges and compare them with the GDP. In a second stage, the model's findings with only one wedge will be compared with the Japanese data and finally in the last subsection, the model's outcomes are presented for two-wedge combinations. Notice, since this is an accounting procedure, the model's output from applying the four wedges simultaneously will not be presented, as it is known they account for 100 per cent of data fluctuations.

5.4.2.1 Japanese trends

All the variables studied in the following point are expressed in per capita values, and were detrended using a 2 per cent rate of technical progress. We can see in figure 2 that detrended GDP per capita grew 11.51 per cent between 1980 and 1991. Then, it falls consistently until 2001. From 1992 to 2001 it shows a decline of 8.16 per cent. In the years between 1995 and 1997 Japan gave a glance of recovery, but a fiscal policy mistake brought back the crisis. Looking to detrended per capita investment, we can trace a similar motion to GDP, but with a higher volatility. Therefore, notwithstanding some initial difficulties, investment in 1991 was 22.64 per cent higher then it was in 1980. Afterwards, its values started to decrease it fell by 21.79 per cent between 1991 and 2001. Finally, employment presented a path of gradual decrease. This decline became steeper after 1992 throughout 2001. The overall drop between 1980 and 2001 was represented by a negative growth rate of 14.70 per cent.

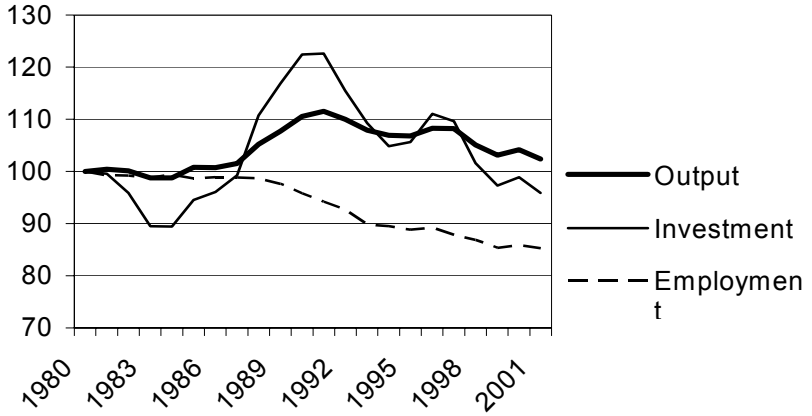

Figure 2 – Japanese detrended per capita values

5.4.2.2 Wedges and Japanese GDP

In Figure 3 the estimated wedges and detrended per capita output are plotted. The efficiency wedge had a slightly negative evolution in the period of the bubble boom. However, between 1980 and 1991 it grew 3 per cent. From this year on to 2001, the efficiency wedge showed a negative growth of −15.3 per cent. Therefore, we can see that this wedge worsened in the crisis period. On the other hand, the labor wedge shows a small positive evolution in the bubble boom period growing 3.17 per cent between 1980 and 1987. Nonetheless, from 1987 to 2001 (the lost decade period), the labor wedge lost 23.5 per cent of its value. The investment wedge fell −2.47 per cent between 1980 and 1989, but it grew 37 per cent in the following 12 years. Finally, the government wedge is the most volatile of all. It grew 14 per cent after the bubble burst until 1995. From 1995 to 1997 it fell 8 per cent, due to the restrictive fiscal policy imposed by the government, and then in 1998 it started to increase again when the public authorities tried to bring the economy up, in a more consistent and determined way.

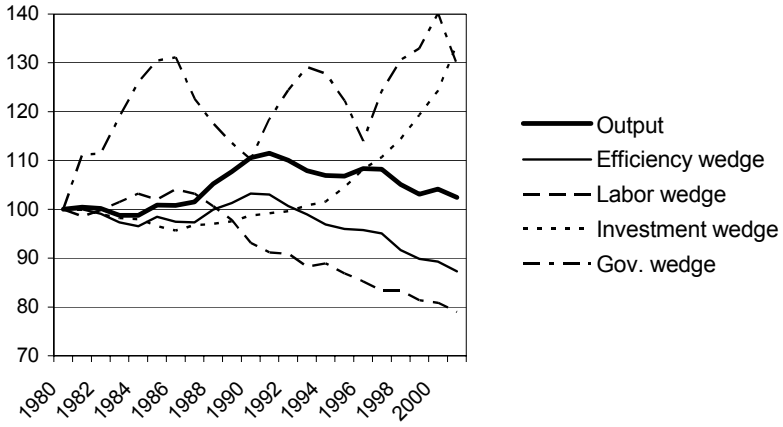

Figure 3 – Detrended output per capita and wedges (1980=100)

5.4.3 Model findings using a single wedge

It is important to notice that in the analysis presented below, four distinctive time periods were defined. The first period goes from 1980 to 1991, representing the bubble boom period. The second one begins in 1991 and goes until 1995, where the consequences of the bubble burst are visible. The third period ranges from 1995 to 1997 when Japan presented some signals of recovery. At last, it is defined the period between 1997 and 2001, as the recovery stalled and the crisis returned.

5.4.3.1Output

Detrended output per capita simulations obtained using the model fed with one wedge at a time are compared with its data values. This can be observed in figure 4.

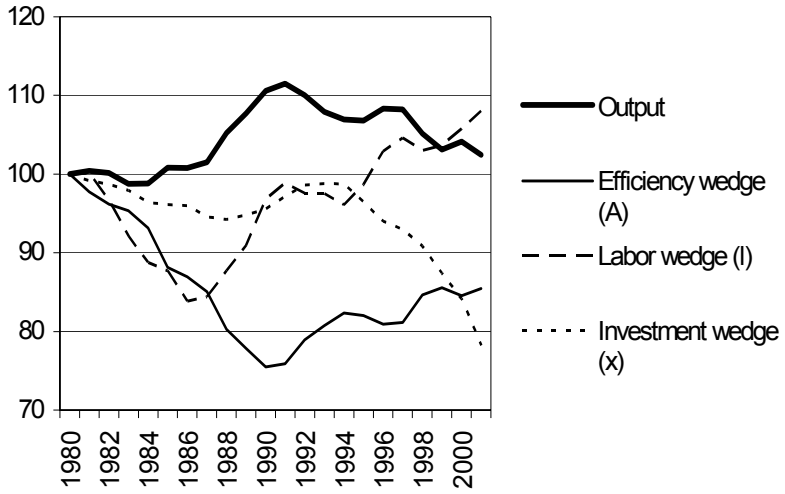

Figure 4 – Detrended output per capita (1980=100)

The efficiency wedge alone would imply a fall of −24.12 per cent between 1980 and 1991 (the boom period), a rise of 6.15 per cent between 1991 and 1995, a drop of 0.9 per cent between 1995 and 1997, and a positive growth of 4.3 per cent from 1997 throughout 2001. As it can be seen in figure 4, the efficiency wedge cannot explain output evolution, as it always produces the opposite growth rates when compared with the ones given by data.

The labor wedge cannot explain the output evolution for the period between 1980 and 1991 since it produces a negative growth of −1.78 per cent. For the period between 1991 and 1995 it explains 3.5 per cent of the fall in output. However, for the years from 1995 to 1997, this wedge gives a growth rate of 5.96 per cent when the output data registers a rate of 1.41 per cent. In the last period, from 1997 to 2001 the labor wedge is not able to explain the output path, as it implies a positive growth of 3.44 per cent.

Lastly, the investment wedge, cannot predict the output evolution from 1980 to 1991, as it generates a negative growth rate of −2.88 per cent. For the period between 1991 and 1995 this wedge explains 13.7 per cent of the output evolution. From 1995 to 1997 it shows a −3.51 per cent growth rate, which is a conflicting result with output data. For the last period, the investment wedge reproduces a growth rate of −14.74 per cent, as the output per capita data presents us a rate of −5.8%.

Observing the wedges effectiveness in predicting output evolution we can say that both investment and the labor wedges out perform the efficiency wedge. The efficiency wedge is not able to explain the output path in any of the defined time periods. The labor wedge, despite of the lack of accuracy, can reproduce some of the observed output evolution. The investment wedge can also explain part of the output path for the periods that go from 1991 to 1995, and 1997 to 2001. However, it is important to see that even when the labor and investment wedges replicate part of the output evolution, they tend to under or over-estimate the data.

5.4.3.2 .Employment

In this section, the time series for employment per capita taken from the data is compared with the model simulations using the efficiency, labor, and investment wedges. Figure 5 depicts both the data and the simulations.

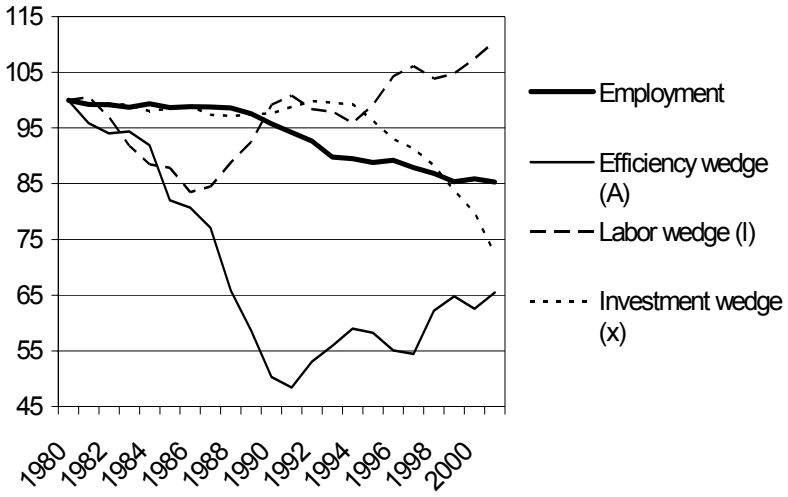

Figure 5 – Employment per capita (1980 = 100)

The model with only the efficiency wedge over-estimates the employment evolution between 1980 and 1991, as it generates a negative growth of −51.5 per cent, when the data registers a negative evolution of only −5.8 per cent. From 1991 to 1995 this wedge does not explains the employment evolution, as it suggests a rise of 9.81 per cent, opposed to a decline of 5.37 per cent observed in data. Between 1995 and 1997, this wedge overestimates, again, the employment data since it produces a drop of −3.78 per cent, when the data shows a fall of −0.95 per cent. In the last period, 1997 to 2001, the efficiency wedge cannot explain the data, as it shows an opposite evolution.

The labor wedge is not able to replicate the data for the periods 1980 − 1991, 1995 − 1997, and 1997 − 2001, as it suggests total growth rates of 0.83 per cent, 7.021 per cent, and 4.39 per cent, respectively. However, for the period between 1991 and 1995 it explains 32.21 per cent of the drop in employment. The investment wedge explains 21 per cent of the fall in employment for the 1980 − 1991 period. For the years between 1991 and 1995 it replicates 46.57 per cent of the labor drop. From 1995 to 1997, and

between 1997 and 2001, this wedge overestimates employment's negative evolution, as it produces rates of −5.21 per cent and −18.9 per cent for periods where the data presents rates of −0.95 per cent and −2.6 per cent.

Therefore, the investment wedge clearly presents a better performance then the other two wedges. Nevertheless, the labor wedge can explain part of the employment progress in the 1991 to 1995 period, and the efficiency wedge normally overestimates employment. In spite of an improvement on the model's accuracy in replicating the employment data (when compared with the output data), the simulations produced by the wedge models tend to overestimate the data.

5.4.3.3 Investment

In figure 6, detrended investment per capita, in the data is compared with the model outcomes, when wedges are put separately.

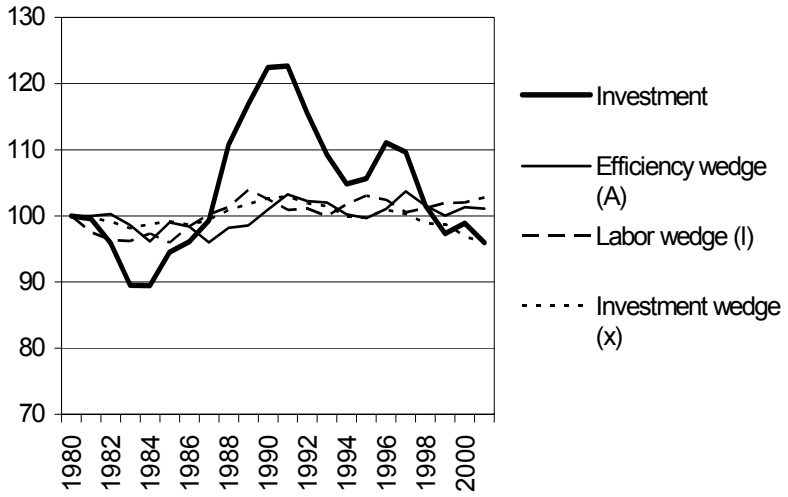

Figure 6 – Detrended investment per capita (1980=100)

The efficiency wedge is comprehensively more precise in replicating the investment. For the period between 1980 and 1991 it accounts for 14.31 per cent of the rise in investment. From 1991 to 1995 it explains 21.1 per cent of the drop. For the time between 1995 and 1997 it presents a growth of 4.1 per cent, as the data registers a rate of 3.97 per cent. For the last period, (1997 to 2001) this wedges accounts for 19.1 per cent of the fall in investment.

The labor wedge captures 3.9 per cent of the investment evolution between 1980 and 1991. For the three remaining periods this wedge completely misses the investment data.

The investment wedge explains 13 per cent of the rise in investment between 1980 and 1991. From 1991 to 1995 it accounts for 18.21 per cent of its drop. For the period that 1995 − 1997 this wedge reproduces 10.75 per cent of the investment evolution. Lastly, between 1997 and 2001 the investment fall is accounted by the investment wedge in 31.71 per cent.

The investment wedge has a very good performance in capturing the evolution of investment. It can, for all the time periods, explain on its own part of its development. However, in accounting for investment evolution this wedge is out-performed by the efficiency wedge, as the later explains the investment path more consistently. On the other hand, the labor wedge misses almost all the investment data, since it can only replicate a very small part of it between 1980 and 1991. Investment wedge keeps a good behaviour, the efficiency wedge improves strongly, and the labor wedge worsens.

5.4.3.4 A brief summary

In the findings presented above, the data values found in for output, employment, and investment were compared with the ones given by the model fed with one wedge at a time. A first conclusion is that this model has some difficulties replicating the output path. For employment and mostly for investment the simulations are more reliable. The investment wedge is clearly the most promising and accurate wedge so far, as it explains reasonably well employment and investment, and it reproduces some of the output evolution. Both efficiency and labor wedges show some problems with the simulations generated by them. Nonetheless, at this point the efficiency wedge seems to out-perform the labor wedge.

5.4.4 Model findings with wedge combinations

In the simulations presented below, the model was fed with three wedge combinations. All these combinations include the government wedge, as the objective here is to compare the performance of the efficiency, labor, and investment wedges. The three possible combinations are the no investment model (which excludes the investment wedge), the no labor model (which excludes the labor wedge) and the no efficiency model (which excludes the efficiency wedge).

5.4.4.1 Output per capita

The no investment model poorly replicates output evolution. Thus, in the periods 1980 − 1991, and 1997 − 2001, it completely misses the data. This model suggests growth rates of −12.8 per cent and 4.5 per cent, when the rates observed in the data are 11.51 per cent and −5.8 per cent, respectively. For the period between 1991 and 1995, this

model reproduces a drop of −5.4 per cent, when the rate given by the data is −4.71 per cent. From 1995 to 1997, this model replicates a growth of 7.66 per cent rise, where the data shows a 1.41 per cent growth.

The no labor model gives us a simulation slightly more accurate then the no investment model. However, it still is a poor performance. In the time period between 1980 and 1991 the data gives a growth rate of 11.51 per cent and this model suggests a negative growth of −12.88 per cent. From 1991 to 1995, this model reproduces a fall of −5.87 per cent, as the data registers a negative rate of −4.71 per cent. In the next two years, it slightly misses the rise of 1.41% in the output data, as it predicts a negative growth rate of −1.806%. For the last period, this model over-estimates the fall in output, since it generates a drop of −13.73 per cent when the rate shown in the data is −5.79 per cent.

The no efficiency wedge has a better performance in accounting for output development then the one demonstrated by the models analysed above. In the first period, between 1980 and 1991 the no efficiency model explains 72.66% of the output rise. For the three forthcoming periods it correctly predicts the output evolution but over-estimates it. Therefore, between 1991 and 1995 it generates a fall of −12.185 per cent; between 1995 and 1997 it replicates a rise of 5.1 per cent; and, lastly, between 1997 and 2001 it reproduces a drop of −14.6 per cent. The data for these three periods presents rates of −4.71 per cent, 1.41 per cent, and −5.79 per cent, respectively. All these results written above can be seen in figure 7.

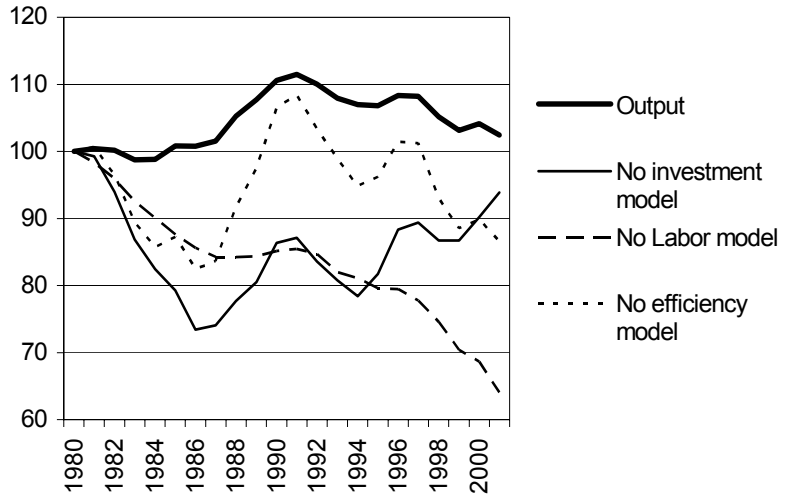

Figure 7 – Detrended per capita output with two wedges (1980=100)

In replicating output per capita, the no efficiency model is comprehensibly the one with the best performance. Nevertheless, it over-estimates the data in the three periods. The no labor model slightly out-performs the no investment model in its simulations. This strengthens the idea that the investment wedge seems to be the most important one in accounting for the "last decade" of the Japanese economy.

5.4.4.2 Employment

The no investment model over-estimates the drop in employment between 1980 and 1991, as it suggests a fall in employment of −37.16 per cent when data reports a drop of only −5.8 per cent. For the period between 1991 and 1995 it explains 92.76 per cent of employment fall. In the next two time periods it completely misses the data on employment.

The no labor model also over-estimates the employment drop between 1980 and 1991. For the period between 1991 and 1995 it generates a fall of −5.76, where the data shows

a drop of −5.37 per cent. For the later two periods it suggests negative growth rates of −4.95% and −12.35 per cent, which over-estimates data, as this shows rates of −0.95 per cent and −2.59 per cent, respectively.

The no efficiency model fails its reproductions in the bubble boom period (1980-1991), and in the period between 1995 and 1997. In the remaining periods (1991-1995 and 1997-2001) it captures the employment drop, but strongly over-estimates it (see figure 8).

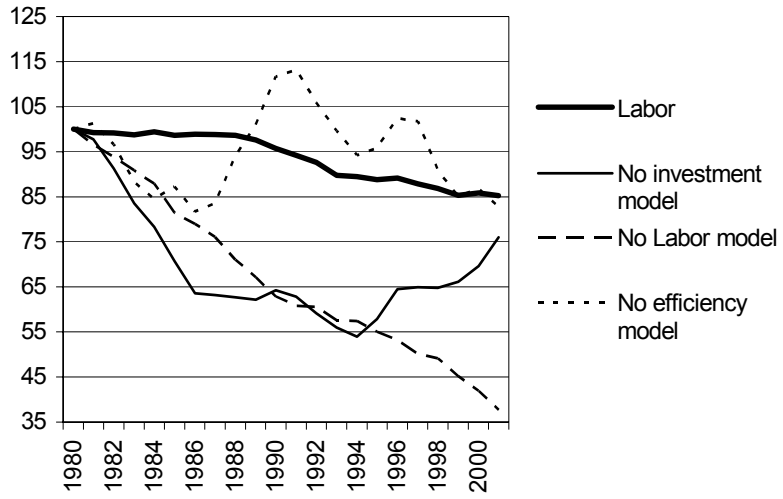

Figure 8 – Per capita employment with two wedges (1980 = 100)

These models improve their performance in simulating employment when compared with their simulations for output. Nevertheless, they keep on over-estimating data values. The no labor model out-performs the other two, as it is able to reproduce for employment fluctuations in the four time periods. Nevertheless, it is important to notice that, once again, the investment wedge is present in the best model.

5.4.4.3 Investment per capita

Although all three models replicate very accurately the investment evolution until 1987, from that point on, only the no labor model keeps a good performance. In the period between 1980 and 1991, this model explains 7.42 per cent of the rise in investment. From 1991 to 1995 it accounts for 11.37 per cent of fluctuations given by the data. It reproduces 4.23 per cent of investment in the years between 1995 and 1997. Lastly, it explains 21.29 per cent of investment evolution in the period between 1997 and 2001.

The other two models, namely, the no efficiency model and the no investment model completely miss investment development given by the data (see figure 9).

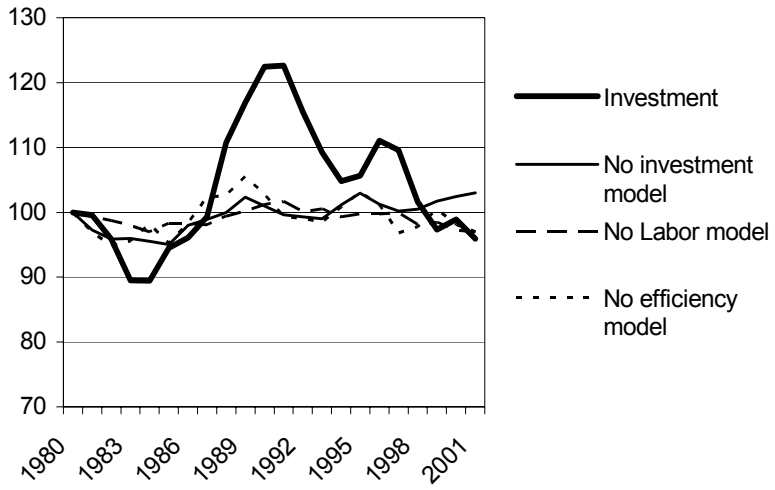

Figure 9 – Detrended per capita investment with two wedges (1980=100)

Once more, the best model includes the investment wedge. The efficiency wedge also continues to make part of the model that best replicates the path shown by data. After analysing all the important simulations a conclusion is stated in the next section.

5.4.4.4Brief summary

The investment wedge is always present in the model that best replicates the data values, reinforcing the idea that this wedge is the most important one in accounting for the Japanese economic crisis. The best overall model with a two wedge combination is the no labor model since it out-performs the other two alternatives in explaining employment, and investment, and presents a reasonable behaviour in replicating output. Thus, the efficiency wedge, in spite of its modest role in explaining the Japanese crisis, has a better performance then the labor wedge.

Therefore, after observing the wedges behaviour, we can say that the most important wedge in accounting for the last decade of the Japanese economy is the investment wedge. The second best wedge is the efficiency wedge that out-performs the labor wedge. Efficiency wedge plays a reasonable role in replicating the Japanese economic fluctuations between 1980 and 1991. The labor wedge plays only a minor role. These models with wedges predict reasonably well labor and investment data, but have some difficulties in explaining output evolution. They also have a slight tendency to over-estimate data values.

Consequently, when creating models to apply to the Japanese economy, economists should never ignore frictions that resemble taxes on investment or productivity losses, e.g. credit market frictions as in Bernanke and Gertler (1989) and Carlstom and Fuerst (1997), or constant technology but where input financing frictions vary over time, as in Chari et al. (2004). Frictions that result in labor taxes do not seem very useful. This is the strongest conclusion of this chapter.

6. Business Cycle Accounting and the literature on the Japanese crisis

The Japanese economic crisis of the 1990's has been a subject of many studies and analysis by a large quantity of economists, as they have been trying to explain why the second largest economy in the world simply stalled its growth in that period. A great variety of explanations were given: some said that Japan had reached its efficiency frontier, and therefore couldn't expect high growth rates; others defended that the Japanese labor system inflexibility harmed its productivity; many that its banking system created an investment channel with large financial frictions.

The outcomes of using business-cycle accounting technology for the "lost decade" were: (i) the investment wedge was the most important in explaining fluctuations in the Japanese economy; (ii) the efficiency wedge had also a reasonable role; and, (iii) the labor wedge played only a minor role. Therefore, when trying to explain what happened in Japan, economic frictions that resemble investment taxes or that results in efficiency losses can never be ignored. On the other hand, frictions that look like labor taxes seem to have no considerable importance in explaining Japan's fluctuations.

Almost all economists, if not all, agree that the creation and burst of the speculative bubble had strong consequences in the economic fluctuations in the 1990's. This is consistent with the business-cycle accounting results. As has it was argued in section 4, the end of the bubble originated mainly investment and efficiency wedges.

Patrick (2002) and Lincoln (1998) defend that one of the major problems in Japan is the excess savings and inadequate demand that increase deflationary pressures. This deflationary pressure possibly causes an investment wedge through a rise in real interest rates, given the fact that nominal interest rates cannot be negative. Business-cycle accounting analysis done here agrees with this opinion, and apparently is not in line with the position of Morana (2004), that defends deflation had no role in the Japanese crisis.

The financial system is, probably, the single most studied sector of the Japanese economic crisis. Patrick (2003), Lincoln (1998), Hoshi and Kashyap (2003), Gower (2000), and Spiegel (1999) are good examples of economists who argue that the Japanese Main Bank System and Convoy System, as well as their deficient deregulation led, to a large quantity of economic frictions that resulted in lost of efficiency and in a strangled investment channel. These consequences resemble efficiency wedges and investment wedges, which are the most important in accessing the Japanese economic fluctuations, according to the model conclusions.

In the crisis period, the Japanese financial system completely failed, as its NPL problem took tremendous proportions. There are two main hipothesis about the consequences of this failure. Some works like Hayashi and Prescott (2002) or Hoshi and Kashyap (2003) argue that the NPL problem led to a collapse in total factor productivity, since banks engaged on a reckless lending policy, financing inefficient and unproductive firms. Other economists argue that the banking crisis led to a credit crunch and, consequently, increasing investment costs. The conclusions of the previous chapter seem support more the second view, as the investment wedge out-performs the efficiency wedge.

Nonetheless, since the efficiency wedge has also a reasonable role in the business cycle simulations, the first hypothesis is not neglectable.

According to Patrick (2004) some typical characteristics of the Japanese corporate governance led to a variety of inefficiencies and moral hazard situations, which also helped to increase Japan's difficulties in recovering from the economic crisis. Thus, for this economist, life-time employment and seniority systems, cross shareholding, strong managerial independence, or labor lay-off reluctance are factors that resulted in productivity losses. The simulation outcomes tend to agree that this kind of distortions had some reasonable weight in the Japanese crisis, since the efficiency wedge plays a considerable role in the Japanese business-cycle accounting.

It is almost consensual amongst the majority of economists that the Japanese government had a very poor performance in tackling the economic crisis. Patrick (2003) or Takatoshi and Mishkin (2004) argue that fiscal and monetary policies applied were always to late, to short, and to ambiguous. They say that this course of action led to bigger deflation pressures on the Japanese economy, not allowing for the recovery. The model's simulations seem to agree with the fact that fiscal and monetary policy mismanagements had a considerable relevance in the Japanese crisis, as their consequence was more deflation, which produces an investment wedge. On the other hand, monetary policies and sticky wages, or political encouragement of monopoly and cartel behaviour among firms, did not have a big importance in explaining Japanese economic fluctuations, as labor wedge only plays a minor role in my business cycle accounting.

Ozawa (2001) argues that the Japanese dualist economic system had some importance in the "lost decade", hence it harmed total-factor productivity. In the face of the model's results, one tends to argue that it possibly had a reasonable importance despite not being one of the strongest causes for the Japanese economic malaise.

The usage of the business cycle accounting methodology to Japan in its crisis period had already been done by Chakraborty (2005) and Kobayashi and Inaba (2005). Comparing the results here produced with both papers, we can observe that they are in line with Chakraborty (2005), as she argues that the investment and the efficiency wedge play a good explanatory role (in this order of importance), in opposite with the labor wedge which plays a negligible role. The conclusion of Kabayashi and Inaba (2005) that labor wedge is the most important one does not fits the model's simulations. This may result from the usage of different periods, different parameterizations, or different parameterizations.

Economists advanced a large variety of economic explanations to what has happened in Japan. The results of the business-cycle accounting procedure in Japan imply that, economists that want to build models that can predict well Japanese economic fluctuations, or want to state some hypothesis about it, should never ignore distortions which resemble investment taxes and, with less importance, efficiency losses.

7. Conclusions

The post-war period was a golden age for Japan and its economy. It started its development process as a poor country devastated by World War II, and at the end of

the 1980's, it was already the second largest economy in the world. Japan built an economy based on modern technology, strong export-oriented firms, and a human capital with extreme quality. Nevertheless, at the end of the 1980's, with the burst of the twin bubble, it entered a long period of economic depression best known as the "Japanese lost decade". This economic crisis had unique characteristics such as: a deep deflationary spiral, a complete failure of the banking system, or its long duration.

These unique characteristics have sparked the curiosity of the academic community, since a large number of economists from all over the world tried to explain the Japanese economic crisis, discover its causes, and advance some solutions. Many of these theories were conflicting among them.

In this dissertation I apply the business-cycle technology developed in Chari et al. (2004) to the Japanese period of economic depression. This technology consists in an equivalence result and in an accounting procedure. The equivalence result argues that models with various economic distortions are equivalent to a prototype growth model with three wedges: an efficiency wedge; a labor wedge, and an investment wedge. These wedges look like time-varying productivity, labor taxes, and investment taxes. Consequently, any economic friction that leads to overall inefficiencies creates an efficiency wedge; economic distortions that lead to labor taxes or investment taxes give rise to a labor or to an investment wedge, respectively. In the accounting procedure we ask which wedge can account more for the fluctuations observed in the Japanese economy. The aim is to state the economic distortion that economists should never neglect in models that want to accurately predict Japanese economic evolution.

The strongest conclusion in this work is that, in accounting for the "Japanese lost decade", the investment wedge is the most important one, as it replicates well the majority of the Japanese fluctuations in variables like output, investment, or labor. The efficiency wedge plays a reasonable role despite not being as important as the previous one. The labor wedge plays a very small role in explaining what happened in Japan. Therefore, economists when explaining the Japanese crisis should focus in models with distortions which lead to investment wedges and efficiency wedges. These conclusions obtained by my model are clearly compatible with the economic mainstream of explanations related to the Japanese economic malaise. Most of the works that try to describe Japan's economic crisis argue for the existence of important distortions which, in the large majority of times, resemble investment wedges and efficiency wedges. Thus, this work's conclusions seem to be in the good direction. The model's outcomes, in spite of being in line with what is argued about Japan by mainstream economists, tend to over-estimate the data realizations. Possibly, it could be due to of the data base used, to the perfect foresight assumption, or to conventions used to deal with net exports.

This business cycle accounting exercise produced the same qualitative conclusions as in Chakraborty (2005), since we both argue that the investment and efficiency wedges are the ones that play a more prominent role. On the contrary, Kobayahshi and Inaba's (2005), state that labor wedge is the most important, a result that is not consistent with the outcomes produced here.

Finally, I repeat my strongest conclusions: (i) Investment wedge is the most important one in accounting for the "lost decade"; The efficiency wedge also has a reasonable role

in that accountability; labor wedge has a very minor role in predicting Japan's economic crisis; (ii) thus, any economic model built to account for the Japanese economic fluctuations should focus in introducing distortions that resembles investment taxes or time varying efficiency; They should neglect possible labor wedges; (iii) My model's results seem to be clearly consistent with what has had been argued, about the Japanese crisis, by the main stream of economists; (iv) and, lastly, analysing business cycle accounting applications to Japan, my estimates tend to agree more with Chakraborty's, and less with Kobayashi and Inaba's.

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9. List of Tables

10. List of Figures